RADIATION CURABLE BARRIER COATING HAVING FLEXIBILITY AND SELECTIVE GLOSS

BACKGROUND AND SUMMARY

The list of conventional chemical compositions for protective coatings includes resin two component systems, solvent based systems and combinations thereof. Urethanes, phenolics, melamines and urea-formaldehyde are examples of resin systems. Several parameters characterize resin systems. In general, these coatings are two component systems, some containing additional catalysts. The two components react together either with heat or through the action of a catalyst or both. Systems reacting at room temperature are usually appreciably toxic, as in the case of two-part urethanes containing typically polyols and multi-functional isocyanates. Compositions which are room temperature stable have low toxicity, but react at elevated temperatures such as phenolics and cannot be used in most cases with temperature sensitive substrates.

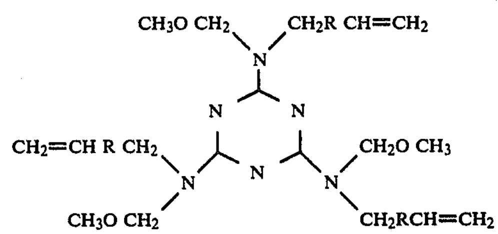
A second group of protective coatings is solvent based and provides solution of high molecular weight polymer solids into a liquid coating by way of a solvent. This group includes polyurethanes, acrylics and enamels for example. Once applied, the coating becomes solid by evaporation of the solvent. Many of the foregoing problems of temperature and toxicity associated with resin systems can be reduced or eliminated by solvent systems, but the resultant physical properties of the coating lack a broad range of chemical resistance due to their lack of crosslinking.

The introduction of ultraviolet and electron beam curable resins have eliminated many of the forementioned deficiencies of conventional coating systems wherein resin systems polymerize and crosslink in situ without a need for conventional solvents, catalysts or heat. The radiation curable resins typically contain alkene reactive groups which react through high energy-free radical initiation. The vast majority of these systems are acrylated epoxies and acrylated urethanes many of which have been formulated for protective coatings, some with excellent abrasion resistance. The exact formulation of these new systems has not been publicly disclosed, but their physical properties have been measured. Typically, abrasion resistance and chemical resistance of these coatings are a function of coating thickness. A coating thickness of one of two mils is normally required to achieve desired properties. Chemical resistance in many cases is proportional to brittleness, the most flexible coatings having the least chemical resistance.

The requirement for a barrier coating having chemical resistance to a wide range of potent solvents yet having flexibility when cured and having excellent abrasion resistance at a coating thickness provided by lithographic printing led us to the development of the present invention. Although melamine resins have found wide use in protective coatings due to their clarity, abrasion and chemical resistance, melamine acrylate has been used as a reactive solvent. Melamine acrylate is a liquid of too low viscosity for lithographic processing and when fully cured via free radical initiation forms a brittle coating. In my effort to find a lithographic formulation providing a flexible coating I discovered that a combination of certain micronsized synthetic silicas, photoinitiators and melamine acrylate provide the desired properties. The silicas are chemically inert and are essentially transparent in the visible and near ultraviolet spectra making them ideal as fillers for a radiation curable barrier. Their particle size and hardness are varied to adjust the gloss of a cured coating. I have found acrylated melamine resin in combination with certain silica fillers and photoinitiators to provide a combination of application and cured coating properties superior in most cases to conventional and radiation curable resins. The advantages include a 100% solid composition which does not require solvents, rapid cure with essentially no heat build up in substrates, easy application to up to 10 micron thickness with lithoprinting processes, and a resulting barrier coating having physical flexibility and excellent chemical and abrasion resistance.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The main ingredient of the preferred coating is trimethoxymethyltri-2-ethoxy-acrylate methyl malamine, herein referred to as melamine acrylate, depicted by the following structural formula:



trimethoxymethyltri-2-ethoxyacrylatemethyl melamine (melamine acrylate).

My preferred formulations by percent weight for sixty percent gloss coating:

- 89% melamine acrylate
- 3% Syloid 166 silica (W. R. Grace & Co.)
- 3% Syloid 385 silica (W. R. Grace & Co.)
- 1% benzophenone
- 1% diethoxyacetophenone
- 1.5% triethanolamine
- 1.0% Cyastat LS (Cyanamid Co.)
- 0.5% Bis (2,2,6,6-tetramethyl-piperidinyl-4) Sebacate

The reaction of several parts (preferably three parts) of hydroxyethylacrylate or other hydroxyl, carboxyl or amide containing alkene with hexamethoxymethyl melamine to form a melamine ring having pendant alkene chemistry and allowing the melamine to cure into a resin via a free radical polymerization mechanism is well known and described for example in U.S. Pat. No. 3,020,255. U.S. Pat. No. 3,020,255 is hereby fully incorporated by reference.

I have found that a six to eight percent by weight incorporation of silicas greatly increases the viscosity of the melamine acrylate making the combination ideal for lithographic coating application while at the same time allowing for a controlled gloss of 60 percent to 35 percent gloss (60° measuring angle) for the reactive additions. These synthetic silicas are micron-sized particles and are readily available from several manufacturers; e.g., W. R. Grace, Philadelphia Quartz Company, in various grades. Particle size is typically 0.005 micron to 25 microns in diameter. The preferred diameter for a matte surface coating is 2–5 microns.